THE ISLAMIC UNIVERSITY – FACULTY OF ENGINEERING

COMPUTER ENGINEERING DEPARTMENT

LCOM 3010 – Introduction to Computer Architecture Lab

Lab #2
ALU Design

BY

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Submitted for

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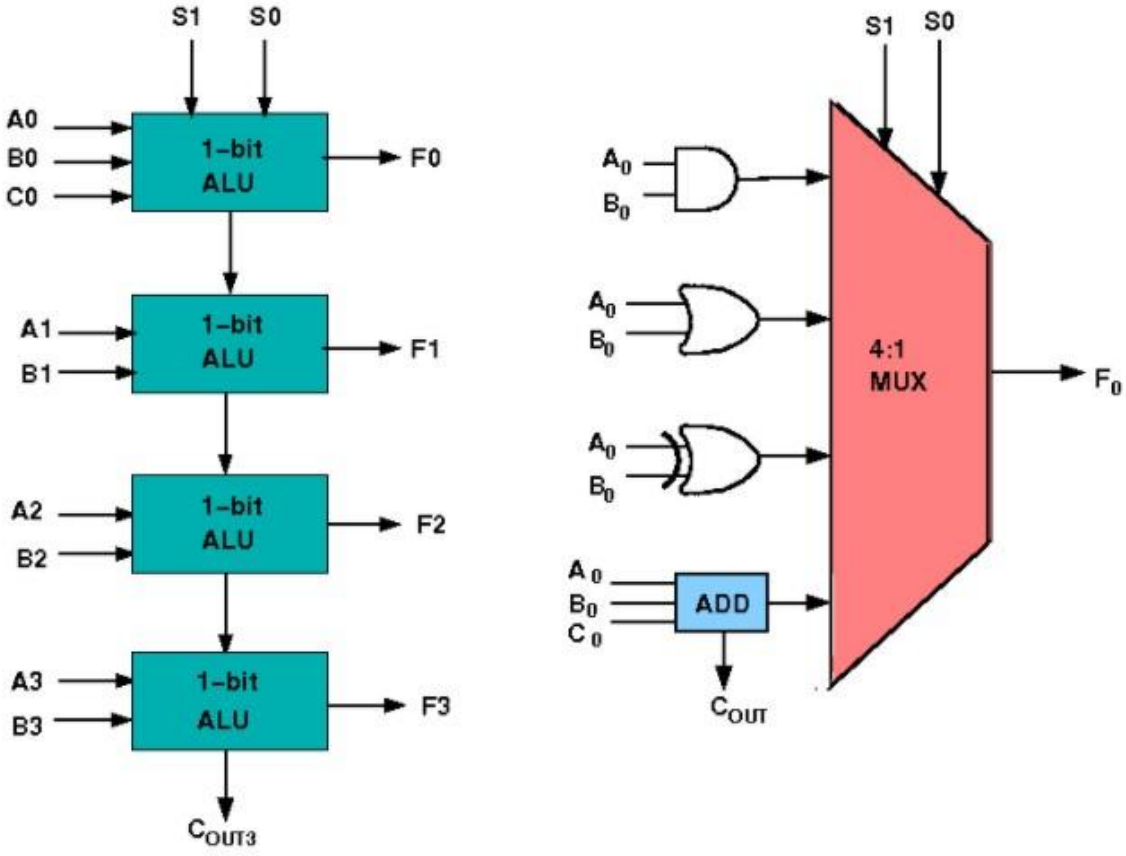
Arithmetic Logic Unit

Objective:

1. Understanding behavior of arithmetic logic unit from working module and the module designed by the student as part of the experiment.
2. Designing an arithmetic logic unit for given parameter.

Theory: Design of ALU:

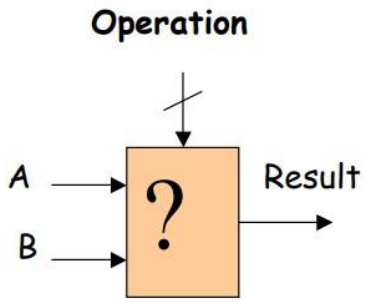
ALU or Arithmetic Logical Unit is a digital circuit to do arithmetic operations like addition, subtraction, division, multiplication and logical operations like and, or, xor, nand, nor etc. A simple block diagram of a 4 bit ALU for operations and, or, xor and Add is shown here:

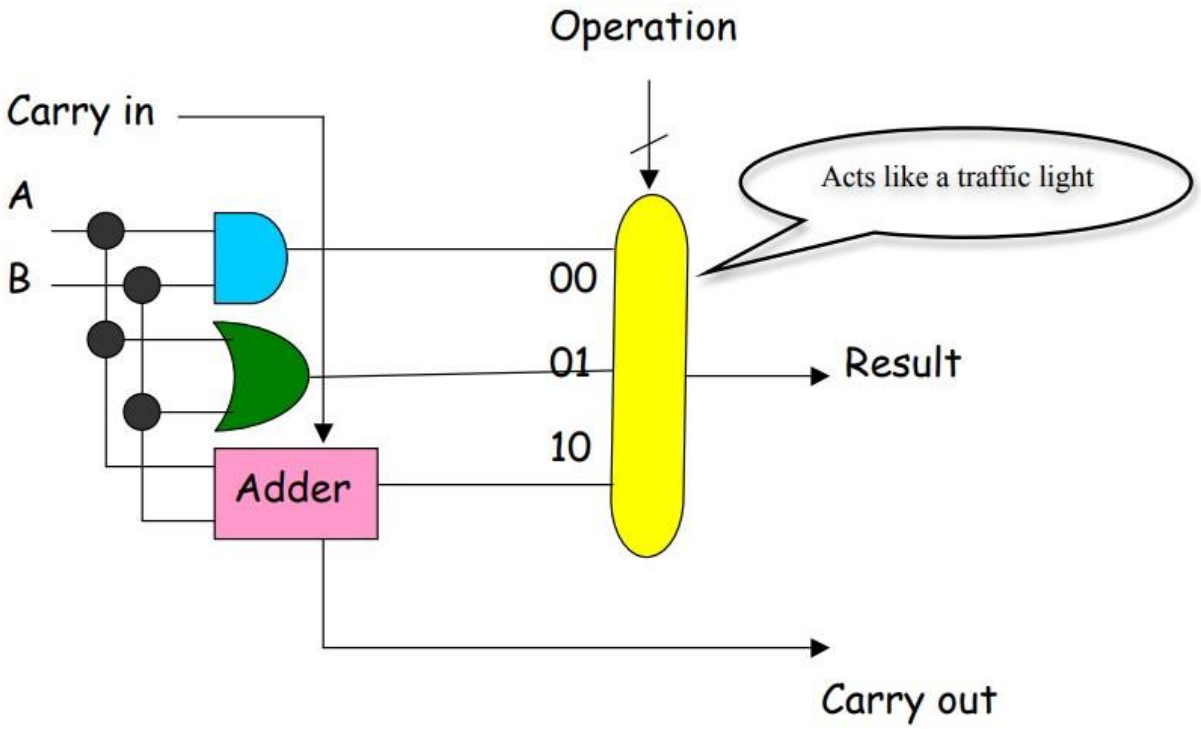


The 4-bit ALU block is combined using 4 1-bit ALU block

A 1-bit ALU Operation:

- Operation = 00 implies AND
- Operation = 01 implies OR
- Operation = 10 implies ADD





♦ Understand how this circuit works.

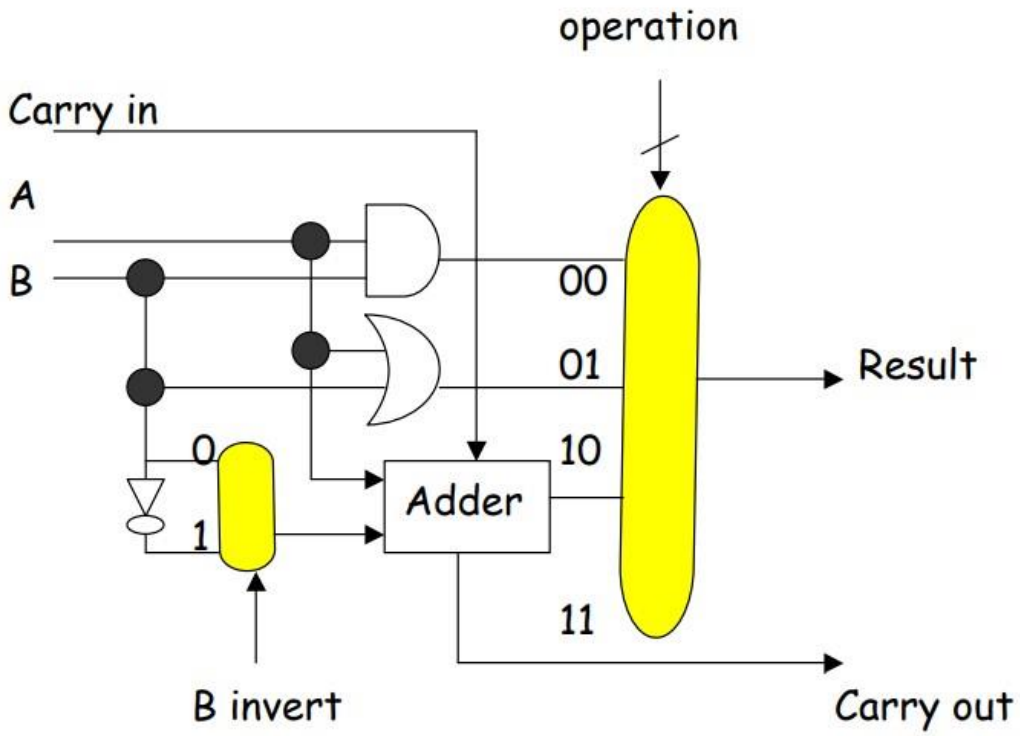
♦ Let us add one more input to the mux to implement slt when the
Operation = 11

Converting an adder into a subtraction:

A - B (here - means arithmetic subtraction)

= A + 2's complement of B

= A + 1's complement of B + 1

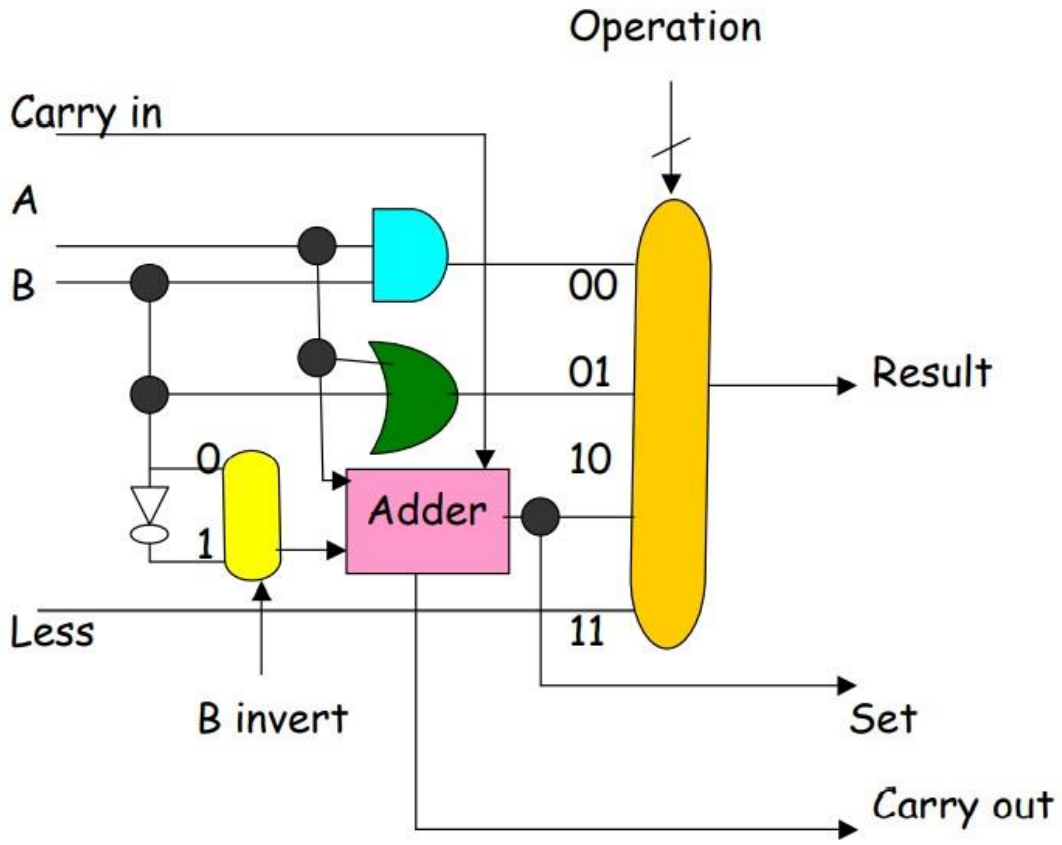


1-bit adder/subtractor

For subtraction, B invert = 1 and Carry in = 1

1-bit ALU for MIPS:

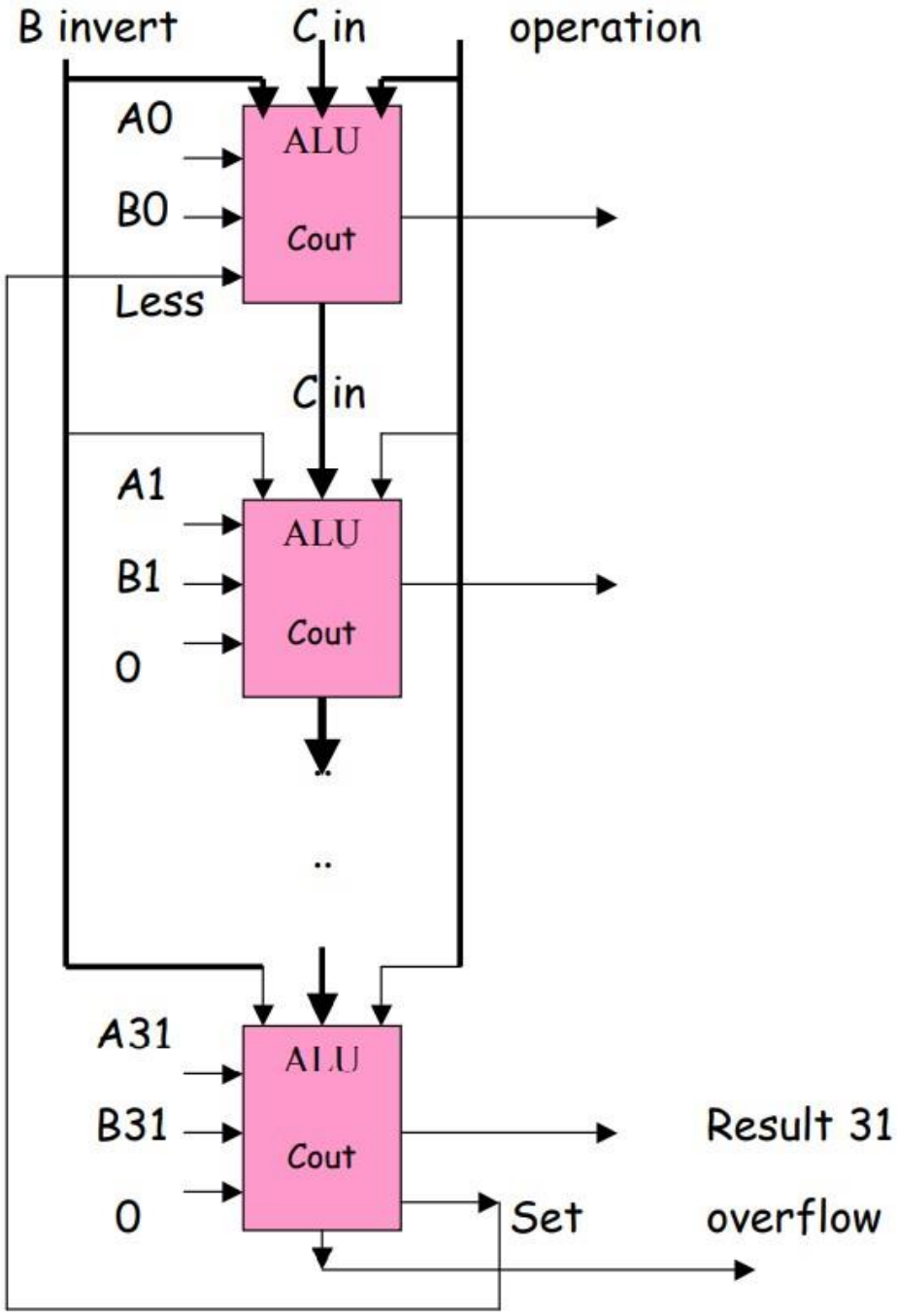
Assume that it has the instructions add, sub, and, or, slt.



Less = 1 if the 32-bit number A is less than the 32-bit number B. (Its use will be clear from the next page)

We now implement slt (If A < B then Set = 1 else Set = 0)

A 32-bit ALU for MIPS



Test plan:

- Set inputs 0101 and 0011 and check output for all possible select input combinations.
- Set any two 16-bit number and check output for all possible select input combinations.

Use Display units for checking output. Try to use minimum number of components to build. The pin configuration of the canned components are shown when mouse hovered over a component.

Assignment Statements:

1. Design a 4 bit ALU comprising only the AND, OR, XOR and Add operations.
2. Design a 16-bit ALU with capabilities similar to 74181. By using Logisim.